

communication circuitry enabling wireless communications and a wired communication circuitry enabling wired communications.

**[0054]** As used in this application, the term ‘circuitry’ refers to all of the following: (a) hardware-only circuit implementations such as implementations in only analog and/or digital circuitry; (b) combinations of circuits and software and/or firmware, such as (as applicable): (i) a combination of processor(s) or processor cores; or (ii) portions of processor(s)/software including digital signal processor(s), software, and at least one memory that work together to cause an apparatus to perform specific functions; and (c) circuits, such as a microprocessor(s) or a portion of a microprocessor(s), that require software or firmware for operation, even if the software or firmware is not physically present.

**[0055]** This definition of ‘circuitry’ applies to all uses of this term in this application. As a further example, as used in this application, the term “circuitry” would also cover an implementation of merely a processor (or multiple processors) or portion of a processor, e.g. one core of a multi-core processor, and its (or their) accompanying software and/or firmware. The term “circuitry” would also cover, for example and if applicable to the particular element, a baseband integrated circuit, an applicationspecific integrated circuit (ASIC), and/or a field-programmable grid array (FPGA) circuit for the apparatus according to an embodiment of the invention.

**[0056]** The processes or methods described in connection with FIGS. 2 to 8 may also be carried out in the form of a computer process defined by a computer program. The computer program may be in source code form, object code form, or in some intermediate form, and it may be stored in some sort of carrier, which may be any entity or device capable of carrying the program. Such carriers include transitory and/or non-transitory computer media, e.g. a record medium, computer memory, read-only memory, electrical carrier signal, telecommunications signal, and software distribution package. Depending on the processing power needed, the computer program may be executed in a single electronic digital processing unit or it may be distributed amongst a number of processing units.

**[0057]** The present invention is applicable to cellular communication systems defined above but also to other suitable communication systems. The protocols used, the specifications of communication systems and their network elements develop rapidly. Such development may require extra changes to the described embodiments. Therefore, all words and expressions should be interpreted broadly and they are intended to illustrate, not to restrict, the embodiment. It will be obvious to a person skilled in the art that, as technology advances, the inventive concept can be implemented in various ways. The invention and its embodiments are not limited to the examples described above but may vary within the scope of the claims.

**1. A method comprising:**

establishing, in a large area cell base station of a cellular communication system, a control connection with a plurality of small area cell base stations comprised in a coverage area of the large area cell base station and belonging to at least two different network operators;

applying, by the large area cell base station, a dynamic spectrum sharing policy for the plurality of small area cell base stations to allocate time-frequency resources

to the plurality of small area cell base stations from a frequency band shared by the plurality of small area cell base stations; and

transmitting, by the large area cell base station, time-frequency resource allocation messages indicating allocated time-frequency resources from the frequency band shared by the plurality of small area cell base stations.

**2.** The method of claim 1, wherein at least some of the time-frequency resource allocation messages are transmitted on a radio resource control protocol layer of a protocol stack of the large area cell base station.

**3.** The method of claim 1, wherein a time-frequency resource allocation message is addressed to a cellular network identifier common to the plurality of small area cell base stations.

**4.** The method of claim 3, wherein the time-frequency resource allocation message further comprises another cellular network identifier that specifies a small area cell base station to which a time-frequency resource has been allocated.

**5.** The method of claim 1, wherein the time-frequency resource allocation messages are transmitted as multicast or broadcast messages.

**6.** The method of claim 1, wherein the frequency band shared by the plurality of small area cell base stations is for use as a secondary frequency resource supplementing a main operating frequency band of the plurality of small area cell base stations.

**7.** The method of claim 1, further comprising:

allocating, by the large area cell base station, a determined time-frequency resource to a group of small area cell base stations; and

transmitting, by the large area cell base station a time-frequency resource allocation message indicating that the determined time-frequency resource is allocated to the group of small area cell base stations.

**8.** The method of claim 1, further comprising in the large area cell base station:

receiving, from a small area cell base station, a resource allocation request;

in response to the received request, determining a time-frequency resource to allocate to the small area cell base station; and

transmitting, by the large area cell base station a resource allocation response indicating the allocation to the plurality of small area cell base stations.

**9.** The method of claim 8, wherein the resource allocation request specifies the time-frequency resource the small area cell base station requests for allocation, and wherein the resource allocation response comprises an information element selected from a group comprising at least the following: an acknowledgment of the resource allocation request, a rejection of the resource allocation, and a proposal of a time-frequency resource different from the time-frequency resource specified in the resource allocation request.

**10.** The method of claim 8, wherein the resource allocation request is a scheduling request without specifying any specific time-frequency resource.

**11.** A method comprising:

establishing, in a small area cell base station of a cellular communication system, a control connection with a large area cell base station detected by the small area cell base station to control dynamic spectrum sharing